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The Garment Industry in Laos: Technological Capabilities, Global Production Chains and Competitiveness*

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Abstract: *This article examines the relationship between institutional support and regional production linkages, and technological capabilities and firm performance in the garment industry in Laos. The evidence shows that garment firms in Laos have achieved considerable technological upgrading, and that firm performance and technological capabilities are determined by export-intensity. Firms' technological capabilities are determined by the quality of host-site institutional support, while foreign firms have invested little to upgrade human capital in Laos. In addition, firms of all ownership structure have invested little in R&D in Laos.*

Keywords: garment, global production chains, Laos, technological capabilities

JEL Classification: L62, L22, L14, O31

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1. Introduction

The economic reforms of late 1990s created favourable conditions for industrialization in Laos, especially in garment manufacturing. Garments contributed 12.6 percent of the manufacturing sector's value added during the period 2005-12. The Lao garment industry was started with just one garment factory in 1984 and the number expanding to more than 100 factories in 2012 from which 54 factories were export oriented. Foreign direct investment (FDI) in the garment industry began to emerge in the early 1990s following the introduction of preferential benefits. FDI in the garment sector accounted for 7.3 percent of total approved FDI in Laos in the early 1990s.The share of garment exports in manufactured export fluctuated between 70 percent and 98 percent over the period 1995-2009 before declining to 54 percent in 2011. Garments contributed around 30 percent of total export revenue between the late 90s and early 2000s. In addition, this industry became an important source of off-farm employment and technology upgrading in the manufacturing sector in Laos. The total employment in the garment sector was around 30,000 workers in 2012, which grew dramatically from 800 workers in 1990. Garments accounted for 19.6 percent of manufacturing employment in Laos in 2012.

FDI inflows opened the way for Laos to enter garment production chains from the early 1990s. Production location in Laos has benefited from several channels, including sources of investors, raw material supply, market for finished goods and other marketing and logistic supports. However, garment production has fallen in significance since 2005 owing to competition from other sites, appreciation in the Kip and rising production costs. This article seeks to examine how the industry has evolved, whether the host-site has had a bearing in technological capabilities, and if the latter has been correlated with regional linkages. The rest of the article is organized as follows. Section two highlights the policy environment for industrial development in Laos. Section three discusses the literature review. Section four presents the methodology and data used. Section five analyses the main findings. Section six presents the conclusions and recommendations.

2. Policy Environment

Industrial policy in Laos could be traced to the "New Economic Mechanism" (NEM) of 1986. Prior to this, the key economic decisions on production were centrally decided by the government and industrial developments followed the planned economy mechanism. Under the centrally planned economic system, economic development of the Lao PDR faced a number of difficulties. The transfer of new technology from abroad was limited as there were only few donors such as Soviet Union and Vietnam. Collective farms were inefficient and unsuccessful, while only few small industrial units were successful (Arshad, 2003). In order to address these increased difficulties facing the Lao economy, the government decided to implement the NEM by introducing several economic reforms, including price liberalization. Importantly, the government introduced reforms in agriculture, state-owned enterprises (SOEs), banking and finance, fiscal, trade, foreign investment policies, and legal and institutional frameworks (Nolintha, Bannalath and Zang, 2011). Industrialization efforts since the NEM was promulgated could be further divided into two periods, namely, the preparatory stage (1986-2000) and the period of boosting economic growth towards industrialization and modernization (2000 to present) (Oraboune, 2011).

Enacting the Business Law in 1994 created a more equal playing field for all businesses in Laos that provided favorable conditions for industrial development. All types of businesses, such as, private enterprise, state-owned enterprise, union-owned enterprise and joint-venture enterprises were treated equally before the law. The private sector was encouraged to participate in various sectors of the economy, except some sensitive sectors, such as, fuel, electricity, water, telecommunications, timber, mining, medicine, alcohol and tobacco.

The introduction of the Industrialization and Modernization Strategy (2001-2020) in 2002 made clear the government's intention to develop the industrial sector as the engine of growth in the economy. This strategy is one of the main thrusts of the 2020 Development Vision. Industrialization and modernization was defined as "the process of transforming national economy from one dominated by the agriculture sector, traditional workforce, low productivity and inefficient production to one that is based on dominance of industrial production supported by modern technology and know-

how" (CPC, 2002). The main objectives of the strategy include strengthening the domestic economy in order to be less reliant on the external sector, modernization of production; expanding the share of industry and service sectors in the economy; bringing electrification to the whole nation, and maximizing the benefits from the increased opportunities arising from integration with the regional and world economy. The implementation of this strategy can be divided into three periods, namely, beginning the integration with regional and global economy (2001-2005), industrialization and modernization (2006-2010), and completing the industrial foundations to graduate from status LDC (2011-2020) (Oraboune, 2011).

The new Investment Promotion Law was promulgated in 2009 to provide a clear policy in managing both private domestic and FDI in Laos (GOL, 2009). This law is particularly important for local investors because prior to this, FDI was treated more favourably than domestic investment. Based on this law, both local and foreign businesses enjoy the same set of duty and tax incentives as well as other benefits. The law also recognises and assures the protection of lawful ownership, rights, and benefits of investors. The Prime Minister Decree on Special Economic Zone and Specific Economic Zone in the Lao PDR was introduced in 2010 (GOL, 2010) as a subordinate legislation to this law. The objective of this decree is to define the principles, regulations, organization, activities, policies relating to special economic zones and specific economic zones (SEZ), aimed at attracting and promoting investment in the development of SEZs. The SEZ is a government designated economic development areas with autonomy in approving, managing and attracting a wide range of industries from different sectors and business. The specific economic zone is slightly different in that the area is aimed to promote specific types of investment and business operations and does not allow people to live inside the area. Special economic zones with an area of 1,000 ha and over could house several specific economic zone.

Laos's foreign trade policies and related trade arrangements also provide favorable environment for industrial development. Laos has been active in negotiating trade agreements both at bilateral, regional and multilateral levels. Laos has trade relations with 50 economies in the world and enjoyed bilateral trade agreements (BTAs) with 16 countries by 2013. BTAs are concluded with economies from various regions, such as ASEAN, East Asia, Eastern and Central Europe, as well as, Argentina and USA. Laos's

BTAs are slightly different from the conventional ones in which most of the BTAs focus on the Most Favored Nation treatment, followed by cooperation promotion rather than increasing market access (NSC, 2007). Exceptions are in the cases of BTAs with Thailand and Vietnam in which market access promotion are the main objectives. At the regional level, Laos participates actively in the ASEAN Free Trade Agreement (AFTA) and is committed to the Common Effective Preferential Tariffs (CEPT) scheme. Under the CEPT scheme, Laos had to reduce tariffs of products in the inclusion list to 0-5 percent by 2008 and to 0 percent by 2015 with some possibility for extension till 2018 for some highly sensitive products. The fulfillment of CEPT commitments, on one hand, will promote more intra-regional trade but at the same time will make it more challenging for local businesses because of fiercer competition. Finally, membership in the WTO in 2013 has taken Laos to another step in economic integration with the global economy, which is expected to bring both opportunities and challenges.

3. Literature Review

Several factors, both at host and home sites, could affect firms' investment decisions in overseas markets. Based on the eclectic ownership, location and internalization (OLI) model, the extent and pattern of international production are determined by these advantages (Dunning, 1988). Ownership advantage refers to specific knowledge capital, such as, human capital (managers), patents, technologies, brand and reputation. Location advantage refers to the value from locating the value-adding activities in particular places. Finally, it is in the best interest of the firms to internalise the uses of firms' specific ownership advantages rather than selling them in the open market. Firms therefore face decision between engaging in the value-adding activities beyond the national boundaries by themselves and sub-contracting such activities to foreign entities. If all of the three advantages are sound then firms are likely to invest in overseas locations. In Dunning's (2005) more recent works, the eclectic theory has been applied to also explain the expansion of cross-border mergers and acquisitions (M&A). The decisions of M&A depends on the willingness and

ability of the investing firms to gain access to new assets and coordinate them with their existing assets and the advantages of countries they are engaging with.

The Flying Geese Model (FG) is another framework that explains the industrialization process in a particular country and the flow of FDI from the leading country to less advanced countries in the region (see Rasiah, Kimura and Oum, fortcoming). In the Akamatsu's original FG model, there are two applications of the model: the basic pattern of industrial development and the variant pattern of industrial diversifications. In the basic pattern, the development of an industry can be divided into three sequences: import, domestic production and export (Akamatsu, 1961; Kojima, 1978; Kasahara, 2004). The fundamental sequences of the FG model show how a country could transform an import reliance economy to import-substituted and finally export-led economy. The variant pattern of diversification can be applied to both intra- and inter-industries. On one hand, intra-industry diversification involves a shift from primary to more complex and refined goods, for example, a shift from cotton to woollen and synthetic materials (Kasahara, 2004). On the other hand, inter-industry diversification refers to a transformation at the national economy level from labour intensive to capital intensive industries, as for example, from textile materials to steel, automobile then computer industries. Kojima (2000) extended the FG model to explain the benefits of expanding FDI from the lead goose country to follower goose countries, showing the importance of regional integration and division of labour. The comparative advantage of the consumer goods industry, for example, textiles, in the lead country will soon decline as wages increase over time. Hence the company in the lead country should invest in the follower country where wages are relatively lower by transferring capital, technology and managerial skills. In doing so, both countries will gain. A similar pattern is then replicated in the other follower countries through "pro-trade oriented FDI". Transnational corporations (TNCs) therefore play important roles in this transformation. Kojima (2000) also argued that there are other spill over benefits, including the development of backward and forward linkages, employment creation, labour skills improvement, and inducement for reforms in the host countries.

The Product Life Cycle (PLC) theory is another important concept that explains the location of production facilities at different stages of product development. Vernon (1966) postulated that each manufactured product goes through three stages: novelty,

maturity and standardization (see Rasiah, Kimura and Oum, fortcoming). In particular, when the product reaches the standardization stage in which production technology becomes routine and cost savings become more important, the production will be relocated to other industrialized and subsequently developing countries. There are several reasons for the shift from export to FDI. Relocation is said to occur to overcome threats from competitors in export markets, and to save on production costs (Vernon, 1971, p.71-73). Vernon (1971) asserts that in the decomposition of production, high value added activities are kept at home because the supporting conditions are more favourable.

In more recent year evidences from developing countries show that many high-end activities have been allocated to host countries. Because of the improvement in technological capabilities at the host country, multinationals have relocated high-end activities offshore to many host sites, including Taiwan, Singapore and India to take advantage of their high technology infrastructure and incentives (Rasiah, Mohamad, Sanjivee, 2011). Multinational corporations have also begun to invest in human capital both in terms of technical and managerial capabilities to support technological upgrading at host sites. In contrast, low technological capabilities at host sites are also associated with low value added activities. Rasiah (2009) and Rasiah, Nolintha and Songvilay (2011), argued that garment manufacturing in Laos has contributed substantially to formal employment creation but the activities are confined to low-value added activities.

4. Methodology and Data

We use a combination of statistical differences and econometric analyses. Firstly, we use comparisons of simple means to examine differences of firms' performance, support enjoyed from meso organizations based on the Systematic Quad model introduced by Rasiah, Nolintha and Songvilay (2011), and linkage with the global production networks. We will also analyse industrial competitiveness by calculating the revealed comparative advantage index and the intra-industry linkage by

constructing the Grubel Lloyd (GL) Index along with various measures of competitiveness.

In the first exercise, we analyzed the intra-industry index developed by Grubel and Lloyd (1975) to examine intra-industry linkages between the national and global garment industries. The following formula was used to estimate GL index:

$$GL_i = \frac{(X_i + M_i) - |X_i - M_i|}{X_i + M_i}$$

Where *X*, *M* and *i* refer to export, import and garments respectively. G-L index takes a value between 0 and 1. If GL equals zero, the country does not have any intra-industry linkage. If GL equals to one, the country is fully engaged in intra-industry trade with no inter-industry trade.

In the second exercise, we used a range of competitiveness indices. The Revealed Comparative Advantage (RCA) is calculated, following the conventional trade theory introduced by Balassa (1965). RCA reveals the relative trade advantage or disadvantage of a country in particular goods and services in the global economy. The country is considered to have a comparative advantage in a good or service if the value of RCA is greater than one or a comparative disadvantage if it is less than one. In addition, other measures of competiveness such as the relative trade advantage (RTA) and the revealed competitiveness (RC) are also calculated. The calculation of RTA and RC follow Vollrath (1991). The RTA is the difference between the relative export advantage (RXA), which is equivalent to the RCA and the relative import advantage (RMA). Therefore, the RTA takes into account both imports and exports. A positive value of RTA indicates that the country has a comparative advantage. Finally, the RC is the difference between the logarithm of the RXA and the logarithm of the RMA. Expressing the index in logarithm allows them to become symmetric in the origin. A positive value of RC refers to revealed competitiveness.

In the third exercise, we adopt econometric regressions to examine the role of linkage with global production on firm performance, technological upgrading and human capital at the host sites. Likert scale scores ranging from 0-5 are used to score firms' rating of the quality of connections and coordination with critical institutions.

The key explanatory firm-level variables are labour productivity, export intensity, technological intensity and size. The control variables are ownership and age. The regional production linkage (*RL*), is the key differentiating variable in the regressions as the exercise is to establish the significance of stronger integration with regional markets on productivity, export-intensity and technological intensities. All variables (including control variables) are subject to a correlation test (see Appendix 1). The highly correlated variables will not be used on the right hand side of the same equation.

Regional production linkage (RL) was estimated using the following formula. Region in this analysis refers to East and Southeast Asia. Separate analyses was run for low and high *RL* with *RL* = 1 when *RL* score exceeded the median figure; *RL* = 0 otherwise.

$$RL = \frac{\left[\left(\text{Regional sales}\right)+\left(\text{Regional purchases}\right)\right]}{\left(\text{Total sales and purchases}\right)}$$

Technological capability (TC) was estimated using the following 5 proxies:

$$TC = f\,(CIQT, AC, PD, RD, TE)$$

Where *CIQT* refers to the cutting-edge inventory and quality control techniques of statistical process control, quality control circles, any one of the international standard organization series, total preventive maintenance, integrated materials resource planning and total quality management. A score of 1 is added for the presence of each of these techniques. *AC* refers to the presence of adaptive capabilities on process, layouts, machinery and products. A score of 1 is given for the presence of each of them. *PD* refers to the presence of product development (1 if existed and 0 otherwise). *RD* is the share of research and development expenditure in sales. *TE* is the share of training in payrolls. The normalization formula $(X_i - X_{min})/ (X_{max} - X_{min})$ is used to convert the value of the proxies to the number between 0 and 1 before the summation. X_i, X_{min} and X_{max} refer to the observed, minimum and maximum values respectively.

Technological intensity (TI) was estimated from the proxies: *CIQT*, *HC* and *TE*. *HC* refers to the share of high skill labours (mangers, engineers, technicians and

supervisor) in the total employment. *CIQT* and *TE* are specified the same as before. Normalization is used before the summation. All technological indices were estimated through adapting similar methodologies introduced by Rasiah (2006, 2008, 2010).

In order to assess the performance of the garment sector, 4 dependent variables were used, namely, value added (VA), the share of value added in the sales (VA%), productivity (sales per employee) and export intensity (X/Y). The controlled variables used are foreign ownership (dummy), firm's age and employment size.

Data Sources

The data used here is drawn from a survey coordinated by the authors and conducted by the research team from the National Economic Research Institute in 2013. The questionnaire used was developed for the Global Production Networks and Host-Site Industrial Upgrading: Evidence from Car, Clothes and Semiconductor Project financed by the Economic Research Institute for ASEAN and East Asia (ERIA). Unless otherwise stated all information presented are for the year 2012. Due to the small scale of the garment industry in Laos, the questionnaires were sent to all garment firms in Laos. Based on the statistics from the Lao garment association, there were 108 garment firms in Laos in 2012. However, our checks showed that only 60 firms were in active production. From the field survey of the 60 active garment firms, 52 firms (86.6 percent) responded. However, the response rate varied with the questions the number of observations (*N*) reported in the tables below differ.

5. Integration and Competitiveness at the Aggregate Level

This section is divided into two sections. First we examine intra-industry trade by time series and compare against neighbouring countries. In the second section, we examine international competitiveness using various indices.

5.1. Intra-industry Trade Linkages

The development of garment sector in Laos is linked substantially to the external sector. Half of the total factories are foreign owned while a quarter is jointly owned by national and foreign capital. Export markets also act the key source of demand for Lao garment firms, especially Italy, England, France, and the United States. A large number of Lao garment firms, especially the small and medium size ones operate as sub-contract operators engaged in simple Cut, Make and Trim (CMT) operations. About one quarter of Lao garment factories engage in more comprehensive operations, such as purchasing raw materials and coordinate part of the transportation of both the inputs and the output. Firms in such operations are engaged in Freight on Board (FOB) operations.[1]

In order to empirically examine linkages between the Lao garment industry and the overseas market, we estimated the GL index for the period 2001-2011. The estimation of GL is explained in section 4. In general, there is still a low intensity of intra-industry trade in the Laos garment industry. The average GL index was 0.18 over the period 2001-11. However, the index is relatively large when compared to other major garment producers, especially Bangladesh, Cambodia, Pakistan, Sri Lanka and China (Table 1). The Grubel-Lloyd Index for Laos at the 2 digit trade statistics is closer to that of Thailand. There could be several implications from this. The majority of Lao garment factories engage in CMT operations, hence, the outputs are mostly exported and therefore Laos has to import similar types of product back for domestic consumption. After further disaggregation of trade statistics to the 4 digit level, the index on average is slightly higher. The disaggregation also reduces data aggregation

[1] Firms in FOB operations purchase fabric, other materials (such as zippers and buttons) and are fully responsible for importing and exporting of all these materials up to loading onto the export carriers. Such firms also sometimes engage in sample making and negotiations with buyers.

problems for some years. For instance, the index for 2010 fell from 79 percent to 31 percent (Table 2). At the 4 digit level, the intra-industry GL index seems to be stable and fluctuates smoother around its mean of 21 percent, which implies that the intra-industry state of garment sector in Laos remain unchanged. This is unlike other more advanced countries like Thailand and Indonesia where the GL index has increased over time.

Table 1: Intra-industry trade and aggregation, Garments, Selected Countries, 2001-11

Year	Bangladesh	Cambodia	China	Indonesia	Laos	Myanmar	Pakistan	Sri Lanka	Thailand	Viet Nam
2001	-	0.06	0.07	0.01	0.12	-	-	0.08	0.07	0.41
2002	0.13	0.06	0.07	0.01	0.09	-	-	0.07	0.08	0.21
2003	0.15	0.05	0.06	0.01	0.12	-	0.01	0.07	0.09	0.16
2004	0.10	0.05	0.05	0.01	0.12	-	0.01	0.07	0.10	0.16
2005	0.07	0.04	0.04	0.02	0.11	-	0.01	0.06	0.10	0.11
2006	0.04	0.04	0.04	0.02	0.08	-	0.02	0.05	0.12	0.06
2007	0.04	0.05	0.03	0.04	0.08	-	0.03	0.05	0.16	0.04
2008	0.01	0.02	0.04	0.07	0.06	-	0.03	0.05	0.18	0.05
2009	0.01	0.03	0.03	0.07	0.26	-	0.02	0.05	0.20	0.05
2010	0.01	0.02	0.04	0.09	0.79	0.03	0.03	0.05	0.23	0.06
2011	0.01	0.02	0.05	0.08	0.12	0.18	0.03	0.06	0.28	0.26
Mean (2001-2011)	0.06	0.04	0.05	0.04	0.18	0.10	0.02	0.06	0.15	0.14
Coefficient of Variation	0.89	0.35	0.30	0.79	1.18	1.07	0.48	0.18	0.47	0.81

Note: Using the 2 digit code, garment export includes garment export including (1) Articles of apparel, accessories, knit or crochet and (2) Articles of apparel, accessories, not knit.
Source: Calculated by Soulaxay Bounthideth and author, based on United Nation (2012) COMTRADE data from World Integrated Trade Solution, Geneva.

Table 2: Intra-industry trade and aggregation, Garments, Laos, 2001-11

Year	4-digit 34 product categories	2-digit 2 product categories
2001	0.19	0.12
2002	0.24	0.09
2003	0.23	0.12
2004	0.25	0.12
2005	0.19	0.11
2006	0.15	0.08
2007	0.22	0.08
2008	0.13	0.06
2009	0.22	0.26
2010	0.31	0.79
2011	0.14	0.12
Mean (2001-2011)	0.21	0.18
Coefficient of Variation	0.26	1.18

Note: Trade-weighted average GL index, different levels of aggregation.
Source: Calculated by SoulaxayBounthideth and author, based on United Nations (2012) COMTRADE data from World Integrated Trade Solution, Geneva.

5.2. International Competitiveness

Although garment is one of the strongest exports of Laos, the competitiveness of this sector against the neighbouring countries has remained weak. In 2011, the share of garment exports from Laos in global garment export was only 0.05 percent, compared to 1.0 percent of Cambodia, 3.4 percent of Vietnam, 0.8 percent of Thailand and 0.2 percent of Myanmar (ITC, 2013). Against this background, this section will evaluate the competitiveness of Laos' garment industry by using various competitiveness indices, productivity and costs.

In general, Laos does have a comparative advantage in garment exports. The calculated RCA is greater than one and the RTA and RC are greater than zero for the whole same period (Table 3 and Table 4). The value of RCA is also higher than many countries in the comparison group except Cambodia, Bangladesh and Sri Lanka. However, Laos's comparative advantage in garment has declined substantially since 2005 while those of the competitors either remain stable or increase. Such decline in the RCA reflects the decreasing role of garment as a major export of Laos after the beginning of natural resource boom in 2005.

The analysis of the RCA at four and six digits level reveal some evidences of the shift in the competitiveness. First, the Lao garment industry has lost the revealed comparative advantage in producing overcoats, anoraks, non-knitted baby garments and baby clothing accessories while gaining the competitiveness in producing underpants/briefs, and night shirts/pyjamas for men/boys . Second, the competitiveness in producing underpants jacket/blazer, trousers/shorts, and shirts for men/boys could be sustained. Finally, the RCA for producing men/boys shirts, T-shirts, pullovers/cardigans, and knitted baby garments and baby clothing accessories have declined substantially but remained above 1.

Table 3: RCA, Garments, Selected countries, 2001-2011

Year	Bangladesh	Cambodia	China	Indonesia	Laos	Myanmar	Pakistan	Sri Lanka	Thailand	Viet Nam
2001	-	24.70	3.99	2.53	13.02	-	-	16.38	1.60	3.97
2002	24.55	22.21	3.68	2.18	13.26	-	-	15.58	1.44	5.03
2003	26.36	25.18	3.50	2.18	13.80	-	6.60	16.51	1.27	5.63
2004	27.50	25.74	3.37	2.19	14.55	-	7.09	17.67	1.29	5.70
2005	28.16	28.00	3.32	2.20	11.33	-	7.14	17.11	1.22	5.39
2006	27.91	29.22	3.62	2.17	7.19	-	7.59	17.06	1.09	5.38
2007	28.59	30.33	3.60	1.99	6.69	-	7.28	16.53	0.89	5.98
2008	35.38	30.48	3.50	1.94	7.21	-	7.08	17.74	0.88	5.99
2009	31.96	18.97	3.25	1.89	5.56	-	6.39	17.03	0.76	5.67
2010	35.00	23.40	3.31	1.78	3.98	1.91	6.94	17.20	0.71	6.04
2011	35.98	25.86	3.29	1.65	3.71	4.51	6.89	17.33	0.63	6.21
Mean (2001-2011)	30.14	25.83	3.49	2.06	9.12	3.21	7.00	16.92	1.07	5.54
Coefficient of Variation	0.14	0.14	0.06	0.12	0.45	0.57	0.05	0.04	0.30	0.11

Note: Using the 2 digit code, garment export includes garment export including (1) Articles of apparel, accessories, knit or crochet and (2) Articles of apparel, accessories, not knit

Source: Calculated by Soulaxay Bounthideth and author, based on United Nation (2012) COMTRADE data from World Integrated Trade Solution, Geneva.

Table 4: Competitiveness Indices, Garments, Laos, 2001-11

	RCA	RTA	RC
Competitive Index	>1	>0	>0
2001	13.02	12.60	3.43
2002	13.26	12.95	3.77
2003	13.80	13.34	3.39
2004	14.55	14.13	3.54
2005	11.33	10.97	3.45
2006	7.19	6.96	3.46
2007	6.69	6.50	3.55
2008	7.21	7.08	4.00
2009	5.56	5.10	2.48
2010	3.98	2.33	0.88
2011	3.71	3.56	3.21
Average 2001-2011	9.12	8.68	3.20

Note: Using the 2 digit level, garment export includes garment export including (1) Articles of apparel, accessories, knit or crochet and (2) Articles of apparel, accessories, not knitted.
Source: Calculated by Soulaxay Bounthideth and author, based on United Nation (2012) COMTRADE data from World Integrated Trade Solution, Geneva.

In addition to a falling RCA in recent years, the industry is facing several other challenges that could affect its competitiveness negatively. Increased labour cost and low labour productivity has added more cost to the industry.[4] The appreciation in the Kip since 2006 has translated into higher costs because most garment factories receive revenue in US dollars but use the Kip for their local payments.[5] Also, utility costs have also increased.[6] Falling competitiveness has resulted in several garment factories closing down. Members of the industry association say that increasing production costs, unfavourable external shocks and local currency appreciation has made the future of the industry uncertain.[7]

[4] Most garment workers in Laos are unskilled. Hence, they only earn the minimum wage set by the government. The minimum wage increased from US$30 USD monthly in 2004 to US$67 in 2009 and US$79 USD in 2012. The problem is severe among CMT firms because labour cost accounted for 63 percent of their total production costs (Nolintha and Saiyavong, 2011). Unit production costs after adjusting for labour productivity of Laos' garment industry was estimated to be 15 percent lower than Cambodia and 20 percent lower than Vietnam in 2010 (Nolintha and Saiyavong, 2011).

[5]The Lao KIP appreciated by 21 percent against USD from 2006 to 2011.

[6] The electricity price for the industrial sector sees major shift in 2012 with a year-on-year increase of almost 20 percent.

[7] Many manufacturing firms in Laos perceive that the appreciation of the Lao Kip has negatively impacted on their performance, while the severest was reported in the garment and agro-processing

6. Institutional Support, Integration and Technological Capabilities

We use the sample in this section to examine the impact of institutional support and regional integration on firm-level technological capabilities. The first section discusses firm characteristics, which is often important in answering the above questions.

6.1. Firm Characteristics

This section discusses the characteristics of firms in the sample. Foreign ownership and export markets are dominant in the sample.

The average age of the sampled firms is 11.1 years, with the oldest firm established in 1984. More than half of the respondents have operated for less than 10 years and only 15.4 percent have over 20 years of operating experience. Firm size varies substantially. The average employment size is 295 and the standard deviation is 393. In terms of ownership, 36.5 percent are fully foreign owned with an average number of employees of 470, while 42.3 percent are fully domestic owned with an average number of employees of 171. The remaining firms accounted for 19.2 percent are joint venture firms with an average number of 472 employees.

Table 5: Basic statistics, Garment firms, Laos, 2012

	N	Minimum	Maximum	Mean	Std. Deviation
Age	52	0	28	10.13	7.61
Foreign ownership	52	0.00	100.00	47.17	46.93
Employees	50	9	2,340	295	393
Sales (USD)	46	15,231.09	18,779,490.00	2,566,511.48	4,423,662.88
Exports (USD)	46	0.00	18,779,490.00	2,537,185.61	4,439,165.70

Source: Compiled from ERIA-NERI Survey, 2013

industries (Bannalath, 2010). Firm level evidence show that the appreciation of Lao Kip alone has caused production cost of garment firms to rise by 12.1 percent in 2006 to 2011 (Insisienmay and Bannalath, 2013).

Domestic firms have highest profit margin and productivity but the difference is not statistically significant (Table 6). This finding is although surprising but consistent with Vixathep (2011) that ownership does not matter for the level of technical efficiency of Lao garment factories. Comparison with regard to overseas affiliation finds that garment manufactures with foreign affiliation record higher profit margin and productivity. Firms that engage in merger or acquisition also perform better and the difference is statistically significant. This sub-section examines the impact on technological capabilities of regional global linkages in the Lao garment industry.

Table 6: Firms performance and overseas affiliations

		Ownership		Overseas affiliate		Merger & Acquisition	
Item	All	Domestic	Foreign or Joint-venture	Yes	No	Yes	No
Profit margin	27	35	25	36	25.7	60*	29*
Sale/workers	77,347	8,752	5,740	7,645	6,629	7,308*	2,858*

Note: * refers to statistical significance at the 10% level.
Source: Compiled from ERIA-NERI Survey, 2013

6.2. Host-site Institutional Support

Garment firms are generally satisfied with the quality of basic and high technological support in Laos. Utilities, telecommunication networks and transport service received high ratings. Universities are ranked moderately, while the quality of training institutes are ranked relatively low (Table 7). Nevertheless, the perceptions are much better than the situation in 2006 (see Rasiah, Nolintha and Songvilay, 2011). R&D-related organizations and institutions received the poorest ratings.

Table 7: Firms assessment on the quality of basic and technical bodies, Laos, 2012

Variable	Obs.	Mean	Std. Dev.	Min	Max
Transport services	52	3.40	1.12	1	5
Power supply	52	3.71	0.96	1	5
Water supply	52	3.46	1.20	1	5
Telecommunication network	52	3.63	0.77	2	5
Public health facilities	52	3.37	0.84	2	5
Primary Schools	52	3.50	0.85	1	5
Technical Training institutions	52	2.81	1.16	1	5
University education	52	3.21	1.09	1	5
R&D scientists and engineers	52	2.71	1.24	1	5
Incentives for R&D activities	52	2.46	1.26	1	5
R&D grants	52	2.25	1.34	1	5
R&D organizations	52	2.25	1.28	1	5

Note: Likert scale score of firms (0-5 with from none to highest possible rating).
Source: Compiled from NERI Survey, 2013

In addition, the quality of many supporting programs, such as government support, industry association and purchasers/sellers' reputation are ranked relatively low (Table 8). These ratings imply that R&D activities and specific industry support program are the areas that need more attention from the government in order to further improve the business environment for the development of the private sector in Laos.

Table 8: Firms assessment of support mechanisms, Laos, 2012

Support mechanism	Obs.	Mean	Std. Dev.	Min	Max
Government support programs	41	2.14	1.31	1	5
Industry association	41	2.15	1.31	1	5
Purchasers/sellers reputation	41	2.63	1.37	1	5
External private marketing agents	41	3.05	1.20	1	5

Note: Likert scale score of firms (0-5 with from none to highest possible rating).
Source: Compiled from NERI Survey, 2013

6.3. Technological Capability, Firm Performance, Regional Linkage and Export Intensity

This section analyses the technological capabilities of garment firms in the sample, and evaluates using simple two-way correlations their link with regional linkages and exports. Simple means using the T-test for equality of means exercise with the Levene's Test for Equality of Variances are deployed in this exercise.

6.3.1. Technological Capabilities

The survey results show that garment producers in Laos use various quality and inventory control, and maintenance systems. International Standard Organization (ISO), Quality Control Circle (QCC) and Total Preventive Maintenance (TPM) are the top three choices. The majority of firms (75 percent) perceive that their machinery is advanced but very few (2 percent) consider them as world class. The incidence of production and product innovation practices were 87 percent and 37 percent percent respectively. In addition, 63 percent of the respondents have upgraded their product and process technologies. The main source of new product technology is their foreign subsidiaries.

Most firms have invested marginally in R&D activities and human resource development: 8.0 percent of the respondents engaged in R&D and on average about 2 full time workers were assigned R&D duties; 5.8 percent of respondents have undertaken contract R&D with domestic individuals and institutions while R&D expenditure accounted for 0.2 percent of sales. Nevertheless, 44.0 percent of the respondents organized some form of training for their workforce. The mean training expenditure was about 4.4 percent of payroll in 2012, which increased slightly from 2006 and 2001 and the amount of training is 240 hours per person per year, again slightly increasing from the previous years. The top three most important human resource development practices reported in Laos' garment industry were teamwork building, strengthening informal contact between managers of different units, and multi-skilling and cross-expertise sharing.

Despite their low intensities, Laos' garment producers do engage in technological upgrading: 61.5 percent of respondents reported that they have improved their technology. The main factors that support technology improvement are proximity to buyers and sellers, favourable input and sale process, firm strategy, regional

production networks, and technological collaboration with buyers and suppliers. Government support in R&D and training, strong support from R&D labs, standards organizations and universities, and levy on training were reported as non-existent or the least important. The respondents consider labour standards, local duties, licensing arrangement, municipal regulations and access to land as the major obstacles for technological improvement.

Laos' garment industry relies on the external sector as the prime market, and source of inputs and finance. Raw materials are also sourced mainly from overseas markets. As expected, firms with overseas affiliation rely more on finance provided by their foreign affiliates. Firms consider their own business strategy, government-firm technology transfer council, presence of business network and technical collaborations with buyers and suppliers as important factors contributing to the development of domestic buyers and suppliers.

6.3.2. Technological Capabilities and Firm Performance

Technological upgrading has assisted Laos' garment manufactures to improve their performance. For example, the order-lead time in 2012 fell from 90 to 30 days in 2004. Table 9 tries to depict the relationship between the performance of Lao garment producers and technology capabilities. Firms with higher technological capabilities were found to have higher value added and productivity, however the difference is only statistically significant with value added. Firms that conduct more quality, inventory and maintenance practices also perform better, though the differences are not statistically significant. Firms engaged in less incremental innovation activities perform relatively better but the differences are not statistically significant.

Table 9: Firm's performance and technological Capabilities

	Number of Incremental Innovation Activity		Number of Quality, inventory, maintenance system practices		Technology upgrading	
	>2	≤ 2	> 1	≤ 1	Engaged	Not engaged
Profit margin (%)	25.2	33.4	32.2	18.9	33.4**	22.1**
Productivity (USD per worker)	5,646	8,254	8,313	6,476	8,376	5,152

Note: ** and * refers to the statistical significance at the 5% and 10% level respectively.
Source: Compiled from ERIA-NERI Survey, 2013.

6.3.3. Export-intensities and Technological Capabilities

Firms with different degrees of export intensity show different technological intensities (TI). Despite having similar workforce structure, high export intensity (EI) firms show higher human resource, process and product technology and R&D intensities than low export-intensity firms (Table 10). Training expenditure is also higher in firms with high EI. However, R&D expenditure is slightly higher in low EI firms. The differences are statistically significant in most variables, which imply that companies with high exposure to export markets are likely to invest more in improving their technological capabilities.

Table 10: Technological intensity and Export Intensity, Garments, Laos, 2012

	EI = 1	EI = 0	P-value of T statistics (2-tailed)
Technical and professional staff in workforce (%)	15.6	19.38	0.332
Training expenses (% of payroll)	5.8	0.4	0.003***
Training hours per person per year	280	97	0.272
R&D expenditure (% of total sales)	5.84	6.24	0.049**
Presence of Adaptive Capability Practices	2.72	1.19	0.05**
Technological Capabilities	1.16	0.99	0.017***

Note: EI =1 if the share of exports to total sales is higher than the median and EI = 0 otherwise.
** and * refers to statistical significance at 1% and 5% respectively.
Source: Compiled from ERIA-NERI Survey, 2013

6.3.4. Regional Linkages and Technological Capabilities

To examine the role of regional linkages, technological capabilities and economic performance, firms with different levels of regional linkages (*RL*) are compared in Tables 11 and 12. The Levene's two-tailed t-test for Equality of Variances only showed few statistically significant differences. Firms with higher *RL* in East Asia have statistically significant higher level of export intensities than firms with lower *RL* (Table 11). However, firms with lower *RL* with East Asia show higher technological capabilities, particularly in product technology. Firms with higher *RL* with East Asia, again, have higher export intensity and engage more in adaptive engineering (AE) capability but score low in overall technological capabilities (Table 12). Interviews suggest that firms exporting out of East Asia use new machinery and equipment as

they meet orders from Western buyers. Yet, firm-level technological capability building is higher when they are integrated more in East Asian markets.

Table 11: Technological intensity and firm performance by the degree of regional linkage (RL) to ASEAN

	Regional Linkage (ASEAN)	N	Mean	Std. Deviation
R&D expense (%)	≥35.00	9	5.53	7.56
	< 35.00	13	3.63	4.81
Training hours	≥ 35.00	10	403.30	876.43
	< 35.00	12	123.75	114.58
Export intensity (%) **	≥ 35.00	21	94.39	21.87
	< 35.00	21	66.67	48.30
Product development (%)	≥ 35.00	22	36	0.49
	< 35.00	22	45	0.51
Technology upgrading (%)	≥ 35.00	22	59	0.59
	< 35.00	22	68	0.48
Training workforce (%)	≥ 35.00	21	0.33	0.48
	< 35.00	22	0.45	0.51
VA (%)**	≥ 35.00	17	23.59	22.99
	< 35.00	18	43.39	23.65
Incidence of product technology adaptation*	≥35.00	20	**2.05**	1.32
	< 35.00	22	**1.45**	0.96
Incidence of adaptive capability practices	≥ 35.00	19	2.68	1.16
	< 35.00	21	2.29	1.27
Percent of technical and professional worker in the workforce	≥ 35.00	21	0.15	0.11
	< 35.00	22	0.19	0.12

Note: ***, ** and * refers to the statistical significance at the 1%, 5% and 10% level respectively.
Source: Computed from NERI-ERIA Survey in 2012-2013.

Table 12: Technological intensity and Firm Performance by Regional linkages, Garments, Laos, 2012

	Regional Linkage (East Asia)	N	Mean	Std. Deviation
R&D expense	≥ 80.00	12	5.73	6.97
	< 80.00	11	3.01	4.21
Training hours	≥ 80.00	13	328.62	772.76
	< 80.00	10	126.10	124.44
EI* **	≥ 80.00	24	95.70	20.39
	< 80.00	22	53.88	50.43
New Product development (%)	≥ 80.00	27	0.33	0.48
	< 80.00	25	0.40	0.50
Technology upgrading (%)*	≥ 80.00	27	0.52	0.58
	< 80.00	25	0.76	0.44
Training workforce (%)	≥ 80.00	26	0.42	0.50
	< 80.00	24	0.46	0.51
VA (USD)	≥ 80.00	17	874,519.56	1,470,131.20
	< 80.00	21	1,180,796.83	2,712,924.17
VA (%)	≥ 80.00	17	26.06	23.63
	< 80.00	21	38.38	23.90
Incidence of product technology adaptation (%)	≥ 80.00	24	1.62	0.97
	< 80.00	24	1.67	1.27
Incidence of adaptive capability practices*	≥ 80.00	22	2.73	1.12
	< 80.00	23	2.13	1.18
Technical and professional staff in workforce (%)	≥ 80.00	25	0.15	0.11
	< 80.00	24	0.18	0.12

Note: ***, ** and * refers to the statistical significance at the 1%, 5% and 10% level respectively.
Source: Computed from NERI-ERIA Survey, 2013

6.4. Host-site Support, Technological Capabilities, Regional Linkages and Firm Performance

This section examines the role of regional trade linkages and host institutional support on technological capabilities and firm performance. The explanatory variables used in this article are regional linkage with East Asia (*RL*), technological capabilities (*TC*), and training expenditure in sales (TE) are the explanatory variables. This separation is to deal with the problem of multicollinearity. Export intensity, which could be an important explanatory variable, is omitted because this variable is highly correlated with the other explanatory variables.

The econometric exercises confirm some of the findings from the univariate analysis above. Firms engaged in substantial technology upgrading are found to be significantly associated with higher productivity. Firms engaged in new product development and adaptive capabilities are associated with firms that could export more. The role of training is only found significant in explaining higher value added but have negative relation with the degree of export intensity. The role of regional linkage is however not statistically significant in explaining the performance of garment firms. This is again consistent with the finding from univariate analysis. Surprisingly, firms with higher degree of regional trade linkages are associated with lower value added. Firms that engage in product development and adaptive capacities tend to also export more.

To examine the role of export intensity in determining firm's performance, two equations were run using EI as the dependent variable in the first and the findings are reported in the Table 13. FO, VA/L and PD were significant and their coefficients were positive. Foreign ownership was highly significant and positive demonstrating that foreign firms' are far more export-oriented than national firms. Labour productivity (VA/L) and product technology were also significant albeit at the 10% significant level. The reverse regression with VA/L as the dependent variable and EI as the explanatory variable produced similar results between these two variables. However, FO showed a negative relationship with VA/L.

The results of the Tobit regressions with technological capabilities (TC) and training expenditure in sales (TE) as the dependent variables are shown in Tables 15 and 16. Export intensity, the quality of intuitional support, regional trade linkage, affiliation with overseas' firms, and merger and acquisitions are the explanatory variables and the usual controlled variables are used. RL and EI are run in a separate equation because of multicollinearity problems. The results show that export intensity and quality of host institutions are correlated with technological capabilities. The role of regional trade linkage, affiliation with overseas' firms, and merger and acquisitions are not statistically significant in any of the equations.

Overall, the evidence shows that export intensity is strongly correlated with firm performance and technological capabilities. The role of regional trade linkage is not significant in any of the exercises. Engaging in product development and technological

upgrading are important for Laos' garment firms. The study also finds that host-site institutional support, particularly in training, is important in supporting technological capabilities.

Table 13: Determinants of export performance, Garments, Laos, 2012

	EI
Equation No.	7
C	27.213 (1.531)
FO	48.312 (3.719)***
Age	0.989 (1.189)
VA/L	0.003 (1.849)*
PD	28.324 (1.803)*
PT	1.858 (0.307)
AC	10.675 (1.608)
N	50
N (after adjustments)	39
F-Stat	4.554***
R2	0.55

Note: ***, ** and* refers to the statistical significance at the 1%, 5% and 10%level respectively. The numbers in parenthesis are the t-statistics.
Source: Calculated by the author, data from NERI-ERIA Survey, 2013.

Table 14: Export intensity and Productivity, Garment Firms, Laos, 2012

	VA/L
C	2919.943 (1.411)
EI	46.172 (2.178)**
FO	-4845.858 (-2.492)**
Age	-188.962 (-1.542)
Employees	2.167 (1.015)
N	50
N (after adjustments)	37
F-Stat	2.453*
R^2	0.23

Note: ***, ** and * refer to statistical significance at 1%, 5% and 10% levels respectively. The figures in parenthesis refer to t-statistics.
Source: Calculated by author from NERI-ERIA Survey, 2013

Table 15: Determinants of technological capabilities, Garment Firms, Laos, 2012

	TC	TC
C	-1.476(-1.59)	-1.368 (-1.24)
EI	**0.01(2.39)****	
Host Institution		**0.524 (1.81)***
Affiliate_Dummy	0.043 (0.12)	0.396 (1)
M&A	0.338 (0.42)	-0.199 (-0.24)
RL_ASEAN		0.004 (1.02)
Employment Size	0.0003(0.8)	0.0005 (1.14)
Age	0.006(0.13)	-0.008(-0.32)
N	45	42
LL	-58.899	-57.832
χ^2	10.88**	9.72**

Note: ** and * refer to statistical significance at 5% and 10% level respectively. The figures in parenthesis refer to z-statistics.
Source: Calculated by the author, data from NERI-ERIA Survey, 2013

Table 16: Training and Technological Capabilities, Garment Firms, Laos, 2012

	TC
C	-0.022
	(-0.96)
TE	5.022
	(6.353)***
E	0.055
	-1.221
Age	0.024
	(3.330)***
N	52
Log-likelihood	3.346**

Note: *** and ** refers to statistical significance at 1% and 5% respectively. Figures in parentheses refer to z-statistics.
Source: Calculated from NERI-ERIA Survey, 2013.

7. Conclusions

The garment industry has been one of the key drivers of industrialization in Laos. The sector has a large share in the manufacturing exports and FDI in the industrial sector. Although its relative importance has declined in the recent years after the booming of the natural resource sector, this sector continues to have an important role in terms of formal employment opportunities. With recent macroeconomic changes and the turmoil in the global economy, the Lao garment industry has faced with numbers of challenges. The comparative advantages of this sector has decline substantially. Other challenges facing the competitiveness of Lao garment industry include local currency appreciation, low labour productivity, wage hike and increase in utility cost.

The industry is integrated in the global production network. Most of the garment firms are either directly linked with the global market such as being invested by foreign companies or having affiliation with overseas company. Firms which are engaged in merger or acquisitions and affiliated with foreign companies seem to perform relatively better in terms of productivity and value added. However, type of ownership does not matter for firms' performances. In addition, evidence shows that foreign

affiliated firms rely on product technology from the parent companies while local companies rely on know-how provided by their foreign buyers. These characteristics support the ownership specific know-how advantage under the Dunning's eclectic model. Despite being integrated in the global production network, the activities of Lao garment firms remain concentrating in the low-value added and low-technological activities of the industry.

The evidence produced shows that garment firms in Laos have been upgrading their technologies. Export intensity is important factor in explaining higher firms' performance and technological capabilities. The quality of host-site institutional support, particularly basic infrastructure is significant for technological capability improvement. However, merger and acquisitions, and foreign affiliation and regional linkages are not significant determinants of firms' technological capabilities. Foreign firms also invest a little to upgrade human capital in Laos. Likewise, both government and garment firms also invest very little in R&D in Laos.

The study proposes that the Lao government to continue the current momentum in improving trade, investment and business environments. Specific support programs on R&D development, industry development and competitiveness strengthening are valuable for the garment industry to survive and compete when Lao economy is increasing its integration with the regional and global economy. Incentives should also be given to encourage private firms to invest more in human resource development, innovation, R&D and technology improvement. Local meso institutions such as training and other high-tech intuitions should be further strengthened in order to attract more high-technology and high value-added segment of the global production network to Laos. Targeted export promotion program and export-led industrialization should be considered for the Lao economy.

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Appendix 1: Correlation test

		EI	TC	HC	Age	Size	RL	FO	Y/L	VA	VA%
EI	Correlation	1	.373*	-.206	-.068	**.343***	.554**	.422**	.232	.277	.042
	Sig. (2-tailed)		.012	.169	.655	.021	.000	.003	.140	.092	.803
	N	46	45	46	46	45	46	46	42	38	38
TC	Correlation	**.373***	1	.084	.112	.179	.091	.103	.160	.035	-.003
	Sig. (2-tailed)	.012		.576	.450	.223	.540	.485	.312	.838	.985
	N	45	48	47	48	48	48	48	42	37	37
HC	Correlation	-.206	.084	1	.275	.046	-.124	.056	-.095	.001	.186
	Sig. (2-tailed)	.169	.576		.056	.755	.394	.701	.551	.996	.265
	N	46	47	49	49	48	49	49	42	38	38
Age	Correlation	-.068	.112	.275	1	.274	-.133	-.165	-.096	-.023	-.090
	Sig. (2-tailed)	.655	.450	.056		.054	.348	.244	.546	.889	.590
	N	46	48	49	52	50	52	52	42	38	38
Size	Correlation	**.343***	.179	.046	.274	1	.047	.350*	.316*	.362*	.037
	Sig. (2-tailed)	.021	.223	.755	.054		.745	.013	.041	.028	.830
	N	45	48	48	50	50	50	50	42	37	37
RL	Correlation	**.554****	.091	-.124	-.133	.047	1	.382**	-.017	-.014	-.185
	Sig. (2-tailed)	.000	.540	.394	.348	.745		.005	.917	.933	.267
	N	46	48	49	52	50	52	52	42	38	38
FO	Correlation	**.422****	.103	.056	-.165	**.350***	**.382****	1	-.117	.018	-.108
	Sig. (2-tailed)	.003	.485	.701	.244	.013	.005		.461	.915	.517
	N	46	48	49	52	50	52	52	42	38	38
Y/L	Correlation	.232	.160	-.095	-.096	**.316***	-.017	-.117	1	.883**	.473**
	Sig. (2-tailed)	.140	.312	.551	.546	.041	.917	.461		.000	.004
	N	42	42	42	42	42	42	42	42	36	35
VA	Correlation	.277	.035	.001	-.023	**.362***	-.014	.018	**.883****	1	.549**
	Sig. (2-tailed)	.092	.838	.996	.889	.028	.933	.915	.000		.000
	N	38	37	38	38	37	38	38	36	38	37
VA%	Correlation	.042	-.003	.186	-.090	.037	-.185	-.108	**.473****	.549**	1
	Sig. (2-tailed)	.803	.985	.265	.590	.830	.267	.517	.004	.000	
	N	38	37	38	38	37	38	38	35	37	38

Note: * Correlation is significant at the 0.05 level (2-tailed); **. Correlation is significant at the 0.01 level (2-tailed).

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